Haematological Profile of Patients with Chronic Kidney Disease in Northern Bangladesh

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Chronic kidney disease (CKD) is a global public health problem, with greater burden and very high cost of care especially in developing countries like Bangladesh. Haematological profiles are commonly affected in CKD and this becomes more apparent as the disease progresses. Few literatures exist on haematological profiles of subjects with CKD in our environment. The objective is to assess the haematological profile of our subjects with CKD in northern regions of Bangladesh. Fifty subjects with CKD at different stages of the disease and 50 healthy adults were recruited into the study. Haemoglobin concentration, PCV, total red cell count, total white blood cell count and platelet count were assessed for the subjects and controls. Results were analyzed using SPSS 17.0 and comparison between subjects and control was made with student's t-test. All the measured parameters for the subjects were significantly different from that of the control. The RBC count, Hemoglobin concentration, Haematocrit and Platelet count is decreased in chronic renal failure patients, which is statistically significant (p= 0.0001). Serum creatinine shows negative correlation with most of the hematological parameters but no correlation with platelet count (r=0.079). Chronic renal failure patients have lower hematological indices, due to impaired production of erythropoietin, and other factors like increase haemolysis, suppression of bone marrow erythropoiesis, haematuria and gastrointestinal blood loss. The concentration of serum creatinine shows negative correlation with all the haematological parameters. And the degree of changes depends on the severity of renal failure.

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Introduction

Chronic Kidney Disease (CKD) is a major health problem throughout the world.[1] It is a global public health problem, with greater burden and very high cost of care especially in developing countries. The exact prevalence rate of Chronic Kidney Disease in Bangladesh is not known. Kidney awareness prevention and monitoring society (KAPMS) reported that about 2 corers people of Bangladesh have been suffering from some form of chronic kidney disease. In a community study it has been found that about 18% peoples are suffering from chronic kidney disease.[2] CKD has been defined as either a level of glomerular filtration rate (GFR)<60ml/min per 1.73m^2, which is accompanied in most cases by signs and symptoms of uraemia, or a need for initiation of renal replacement therapy.[3]

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Haematological parameters are commonly affected in CKD. Of all the parameters, red cell indices are the ones commonly and severely affected. This is because as high as 90% of erythropoietin is produced in the juxtra-glomerular apparatus of the kidney while 10% are produced in the liver and other organs. The severity of affectation depends on the stage of renal failure. Changes in red cell indices are due to a number of factors aside erythropoietin productions. Deficiencies of iron, vitamin B12 and folate as a result of nutritional insufficiency or due to increased blood loss[4] are contributory factors. Shortened red cell survival,[5] hyper parathyroidism,[6] mild chronic inflammation[7] and aluminum toxicity[8] have also been implicated.

Anaemia is a consistent and severe complication of CKD[9] and its occurrence as the disease progresses is well established.[10] The severity of anaemia increases along with the progression of the disease.[11] Anaemia has been shown to start appealing at GFR below 60ml/min,[12] but more prevalent when it falls below 30ml/min (or stages 4 and 5 of CKD).[13] Severe anaemia is a common feature in Nigerians with CKD and is strongly associated with severity of CKD.[15] Haematocrit correlates inversely with the degree of renal failure as assessed by serum creatinine.[15]

Beside red cell indices, white blood cells, platelets and coagulation factors may also be affected. Most authors reported total white cell count, platelet count and bleeding time of normal ranges,[14] but striking eosinophilia.[15] Prolonged bleeding time has also been reported.[15]

Literature on haematological profiles of patients with CKD in Bangladesh is sparse. Also no such study has been conducted in the Northern region of Bangladesh. So we therefore decided to evaluate the haematological profile of our patients with chronic renal failure pre dialysis.

Methods

Effects of Chronic renal failure on Hematological parameters is a cross-sectional study, conducted at Rangpur Medical College Hospital, a tertiary care hospital in Northern region of Bangladesh. Fifty adult patients with CKD at different stages of the disease were recruited consecutively from Nephrology Unit of the hospital for the study. Fifty apparently healthy age and sex matched adults who were mainly staff of the hospital were also recruited into the study as controls. The subjects were selected under the age between 25to 65 years and serum creatinine >1.5 mg/dl, and exclusion criteria of serum creatinine < 1.5 mg/dl, patient already on dialysis, those with active infections, those with bleeding disorder and chronic liver disease and those with anaemia not related to CKD were excluded from the study and patients suffering from muscular atrophy. Verbal consent from the patients and controls and hospital ethical approval were obtained before commencing the study.

Five ml of venous blood sample was collected into ethylene diamine tetra acetic acid (EDTA) and plain tubes from each patient and controls for hematological and biochemical analysis respectively. Hematological parameters like Red Blood Cell count (RBC), Haemoglobin concentration (Hb%), Packed cell volume (PCV), Platelet count and Total Leucocyte count (TLC) were estimated by using Beckman coulter automatic analyzer, and the serum creatinine, serum ferritin were estimated by fully automated random access chemistry analyzer (Humastar 300).

The results were analyzed statistically using SPSS 17.0. Mean and standard deviation of every parameter were calculated. The results

of subjects and controls were compared using student's t-test.

Results

A total of 50 CKD patients were included in the study. There were 33 male and 17 female with a male female ration of 1.9:1.The mean age of the patients was (41.22±2.0) years (ranges between 22-65 yrs) and the mean RBC, haemoglobin, serum creatinine concentration, platelet count and PCV were 3.06±0.65, 4.96 ±0.32 gm/dl, 430.74± 11.92 µmol/L, 246.50 ± 13.63 x10^9/L , 27.13±4.41 respectively (Table I).

The RBC count, Hemoglobin concentration, Haematocrit & Platelet count is decreased in chronic renal failure patients, which is statistically significant (p=0.0001) Table II. Total leukocyte count is decreased in chronic renal failure patients, which is not statistically significant (p= 0.380). The serum creatinine level is increased in chronic renal failure patients, which is statistically significant (p= 0.0001). Serum creatinine shows negative correlation with most of the hematological parameters but no correlation with platelet count (r=0.079). Serum creatinine is increased and is statistically significant (p=0.0001) Figure 1 and 2.

Table I: Characteristics of 50 CKD patients

Total number of patients	50
Mean age	41.22 ± 2.0
Sex	
Male	33
Female	17
Mean age	41.22±2.0
Mean RBC	3.06±0.65 mill/mm^3
Mean haemoglobin	4.96 ±0.32 gm/dl
Mean serum creatinine	430.74± 11.92 µmol/l
Mean Platelet count	246.50 ± 13.63x10^9/l
Mean PCV	27.13±4.41

Table II: Comparison of haematological parameter between study and control group

Groups	RBC million/mm^3	Hb gm/%	PCV %	TPC Lac/mm^3	TLC thousand/mm^3	Creatinine gm/dl
Control(n=50)	4.83±0.36	13.49±0.88	40.92±2.41	2.88±0.55	8376±1507	0.95±0.22
Study(n=50)	3.06±0.65	8.83±1.78	27.13±4.41	1.59±0.57	8054±2156	4.76±2.29
p value	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

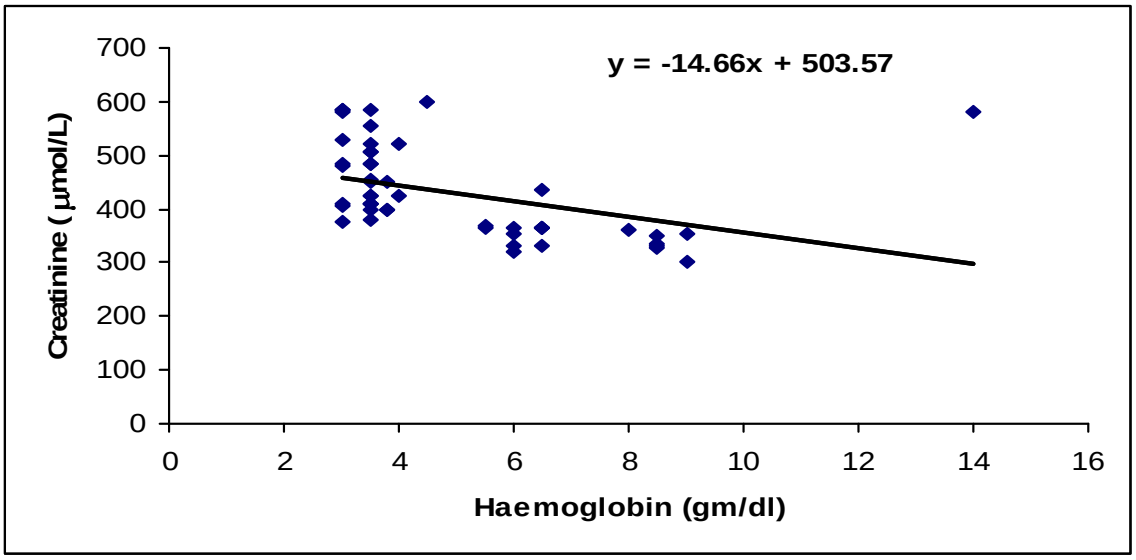

Figure 1. Scattered diagram showing the negative correlation between haemoglobin concentration and serum creatinine

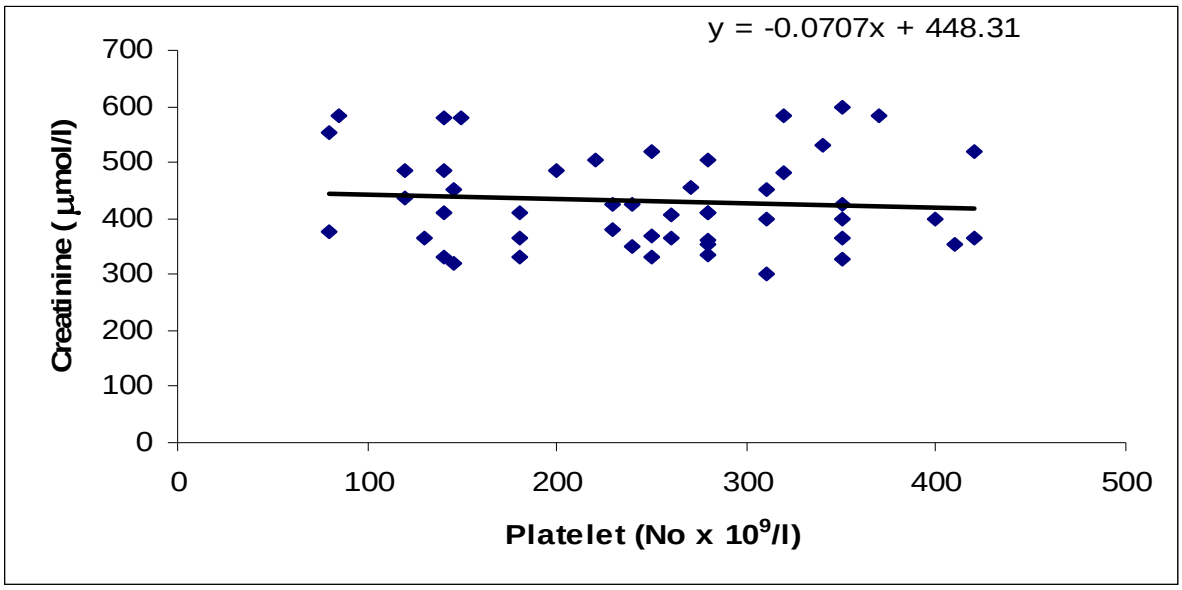

Figure 2. Scattered diagram showing no correlation between platelet count and serum creatinine

Discussion

The hematological parameters in 50 chronic renal failure patients compared with 50 age and sex matched controls. In our study, it has been observed that the RBC count is decreased (Table II) in chronic renal failures ($p<0.001$, highly significant). Primary cause of decrease RBC count in chronic renal failure is impaired erythropoietin production and other factors which suppress marrow erythropoiesis and shortened red cell survival. Erythropoietin is the hormone which is the major humoral regulator of red cell production and helps to maintain the viability of RBC by retarding the cleavage of DNA that occurs normally in CFU-Es. In the absence of EPO, DNA cleavage is rapid and leads to cell death.

RBC survival is decreased in uremic patient's in proportion to the blood urea nitrogen concentration and, it improves significantly after intensive haemodialysis. Uraemic plasma increases the expression of phosphatidylserine on the outer cell surface in red blood cells. This enhances the recognition of damaged red blood cells by macrophage, leading to their subsequent destruction and decreased survival.[16]

The hemolytic factor implicated in decreased red blood cells survival is presumed to be a toxic substance normally excreted or metabolized by the kidneys, one such substance is guanidine and its derivatives which appear to be a subset of the many retained metabolites, adversely affect erythrocyte survival.[17]

The hemoglobin concentration and haematocrit are decreased (Table II) in chronic renal failure patients. ($p< 0.0001$, highly significant. The hemoglobin concentration and haematocrit generally provide an accurate reflection of the extent to which the circulating red cell mass is reduced. In chronic renal disease because of impaired erythropoietin secretion, increased destruction of red blood cells, leads to a fall in red blood cell count, which reduces the hemoglobin concentration and haematocrit. A decrease in haematocrit is apparent even among patients with mild to moderate renal insufficiency.[18]

An inverse relationship between serum or plasma erythropoietin levels with hemoglobin (Hb) concentration and haematocrit (PCV) normally exist. As the hemoglobin and haematocrit decreases the erythropoietin level rises. The known negative correlation between serum erythropoietin and Hb and PCV was not apparent in our study, probably because of loss of renal mass leading to decreased erythropoietin in spite of anaemia.

It has been observed that the platelet count is decreased (Table II) in chronic renal failure patients($p< 0.0001$, significant). Erythropoietin potentiates the effect of megakaryocyte colony stimulating factors, acetlyhydroase (PAF-AH) and paraoxonase (PON1). In chronic renal disease, impaired erythropoietin secretion leads to a decrease in platelet count.[5] The detection of receptors for erythropoietin in megakaryocytes is understandable, because erythropoietin levels can affect platelet level and because of extensive homology between erythropoietin and thrombopoietin, erythropoietin act as the major humoral regulator of platelet mass.

In patients with chronic renal disease treated with erythropoietin, a minor increase in platelet count, averaging approximately 30,000 per microliter has been noted. The decrease in platelet count in patients with chronic renal disease leads to prolonged bleeding time and altered haemostasis.[19] It has been observed that the total leukocyte count (TLC) is reduced than the control, (Table I) which is not statistically significant ($p = 0.38$). The precise mechanism by which chronic renal disease leads to a slight decrease

in total leukocyte count is not clear. The possible hypothesis is as follows.

In chronic renal failure patients undergoing dialysis, in the dialyser, exposure of blood to artificial membranes may result in complement activation in vivo. The complement is typically C3a or C5a, produced by the classic complement activation pathway. Complement activation induces neutrophil aggregation and adherence to endothelial surface with resultant fall in total leukocyte count. In patients undergoing haemodialysis the incidence of this affect may be as high as 20%.[20]

The serum creatinine level is increased in chronic renal failure patients ($p< 0.0001$, highly significant, Table II). Chronic renal disease, creatinine clearance is affected which results in increased serum creatinine. Estimation of serum creatinine is used as a diagnostic test to assess kidney function. Creatinine level more than 1.5 mg/dl indicates impairment of renal function. Serum creatinine shows negative correlation with all the haematological values.[21]

Conclusion

Results of this study concluded that patients with chronic renal failure show abnormal haematological parameters The concentration of serum creatinine shown negative correlation with all the haematological parameters. Chronic renal failure patients have lower haematological indices and the degree of changes depends on the severity of chronic renal failure.

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